Biogeochemical and Hydrologic Cycles: Feedbacks Between the Arctic and the Global System-

The Paleo Perspective from PARCS and RAISE

Paleo research allows us to ask what has occurred in the past to better understand the future in terms of:

1. The nature of natural variations in the Arctic-Global system

2. The response of the system to major and minor perturbations

Examples...

PARCS (and GISP)

High resolution records from ice cores, lake cores marine cores and tree rings indicate individual and quasi-cyclic shifts in the arctic land-marine-atmosphere system that correspond to similar events detected elsewhere

Uncertainties…

Eastern Canadian Arctic Climate Variability over the last 700 years

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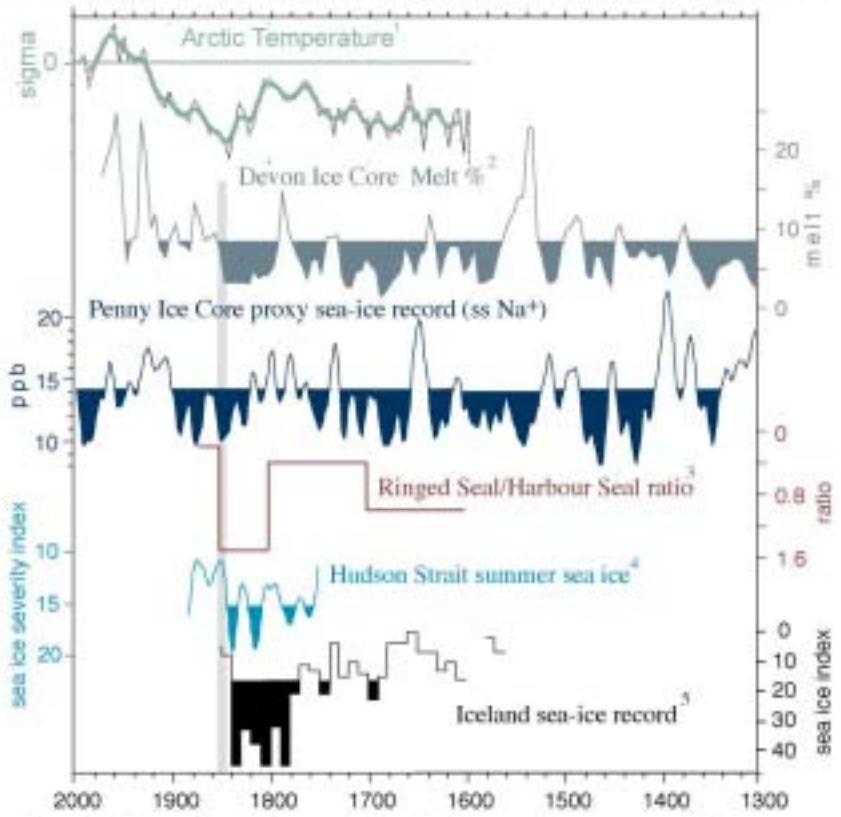


Comparison of the Penny Ice Cap record of springtime sea-ice coverage with reconstructed Northern Hemisphere high latitude and Arctic temperature changes determined from multi-proxy analyses[1] (PALE; Overpeck *et al.*, 1997), percent melt from the Devon Ice Cap ice core[2] (Fisher and Koerner, 1994), ratio of ringed Seals to Harbor Seals[3] (inverted y-axis) as determined from counting of seal bones at archaeological sites (Woollet, 1999), Hudson Strait summer sea-ice[4] (inverted y axis) determined from ships logs (Bergthorsson, 1969; Catchpole, 1992) and sea-ice index for Iceland[5] (inverted y-axis) reconstructed from journals (Ogilvie, 1991; 1992). The shaded areas for each record identify periods characterized by colder temperatures or more extensive sea-ice (relative to their respective 1,000 year mean). The gray vertical line highlights the Franklin Era (1845-1857) (Alt et al., 1985) which was characterized by exceptional sea-ice extent in the Canadian Arctic.

…What drives such shifts?

Is the arctic responsible or responsive?

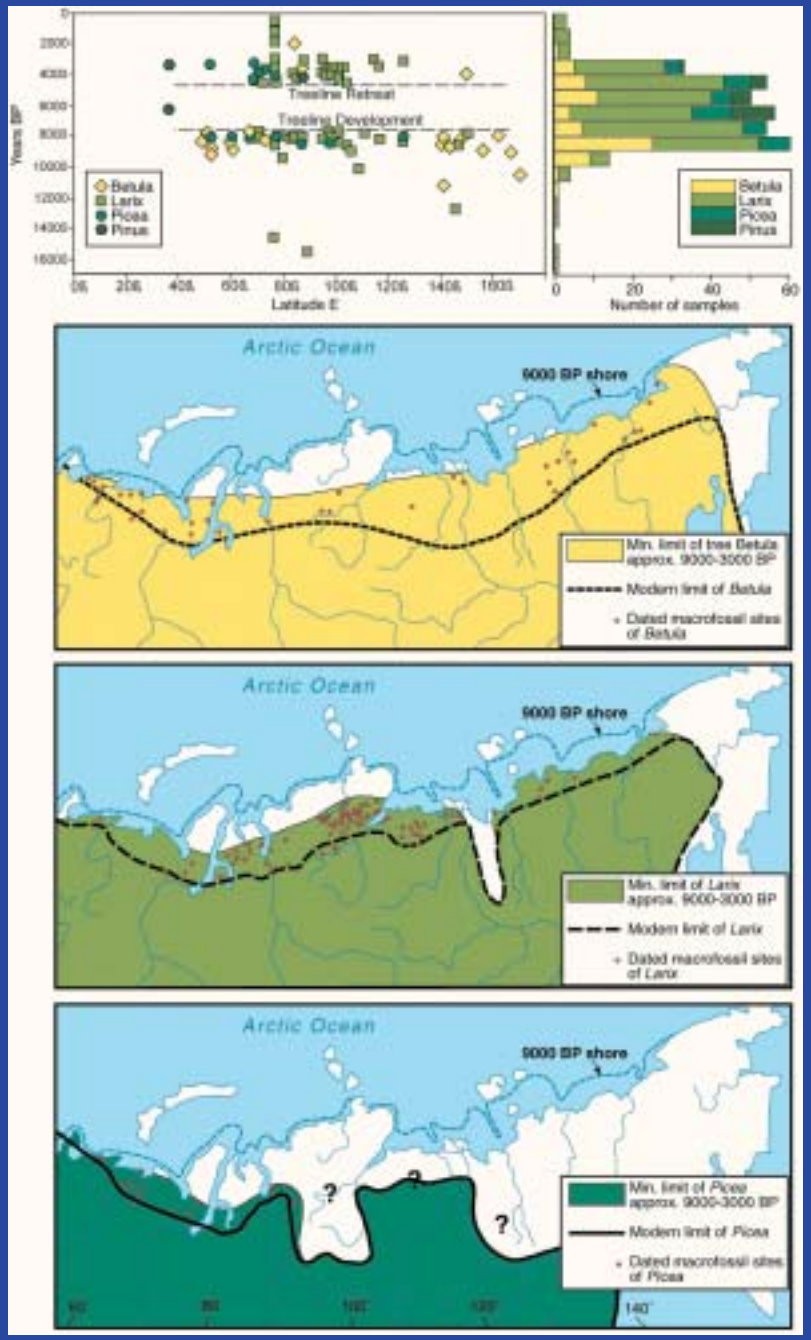
How pervasive and persistent
are their impacts geographically
and temporally?

Will such shifts persist in a
greenhouse world?

PARCS

The status quo has not always been...

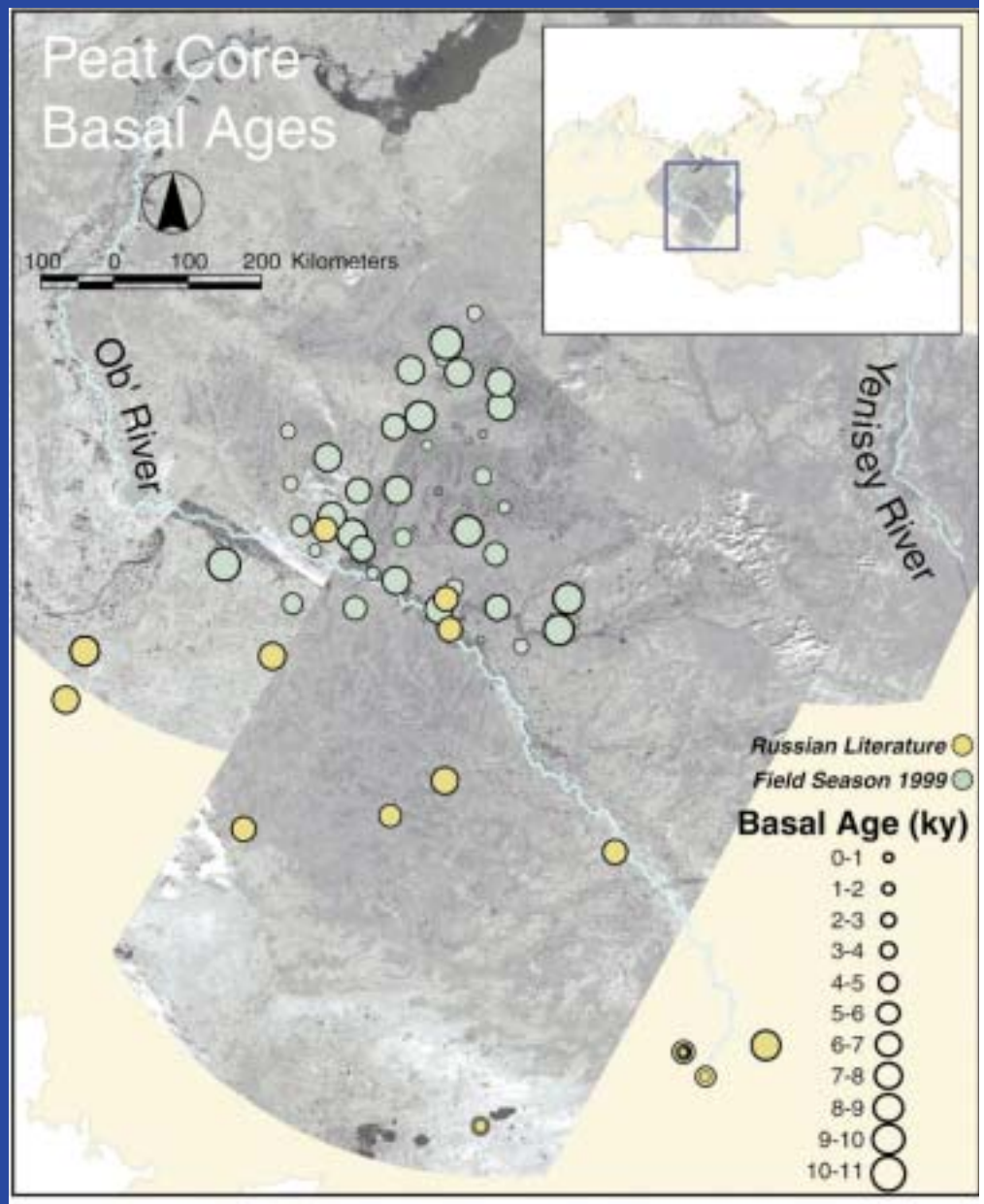
Paleo research shows that the Arctic has been warmer than present with different vegetation feedback conditions. For example - 6000 years ago forests were more extensive in the north



RAISE

Extensive stores of carbon such as the peatlands of west Siberia did not exist until after 10,000 years ago

Uncertainties...

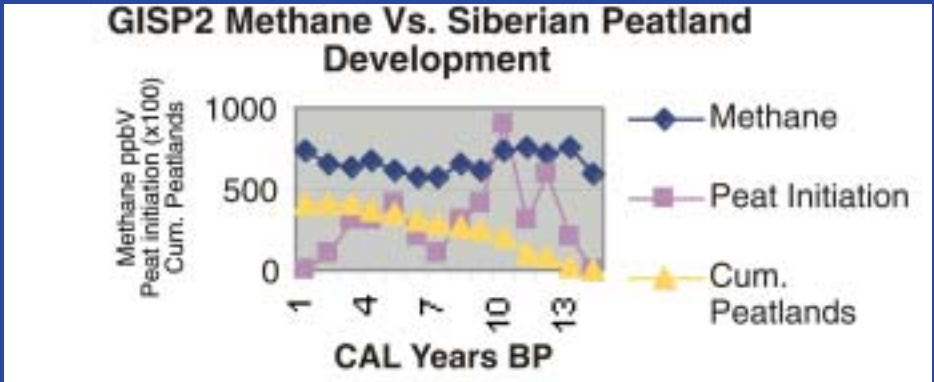


Radiocarbon dates for the start of peat accumulation range from ~1000 ye BP to ~11,000 BP.

...How do such things as prolonged ‘warm arctic’ conditions feedback and impact the global climate system?

How fast can major state changes in arctic climate, carbon storage of methane production occur?

Can we anticipate such conditions and state changes in the future?



Comparison with peatland initiation in Western Siberia and the GISP2 methane may be partially controlled by peatland development rates in western Siberia.

Answers...

Closer integration of paleo and non-paleo ARCSS community to identify critical phenomena and driving mechanisms for study

Closer integration with modeling community to understand potential feedbacks and dynamics and develop critical tests based on use of emprical data and models

Strategic selection of paleo proxies and geographic regions for sampling